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Associated Universities, Inc.
Upton, New York

AGS DIVISION TECHNICAL NOTE

No. 130

BEAM SIZE MEASUREMENTS FOR FEB

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January 13, 1977

The fast extracted primary proton beam size was measured between UQ13 (last quadrupole before the neutrino horn) and the neutrino horn. We exposed the wire mesh of 100 X 100 wires per inch in the beam and counted the radio-activity induced by the beam for each wire. Because of the availability we used the nickel alloy mesh. If the wires are reasonably homogeneous, the result should not be affected by the kind of material we use. About 10^{14} protons (20 pulses of $\sim 5 \times 10^{12}$ protons per pulse with $> 95\%$ extraction efficiency) were impinged onto the wire. The mesh was taken apart and the individual wires were counted. We used several counters to count the wires, but the efficiency of the counters were the same within a few percents. A wire from each mesh was counted all the time to serve as the normalization. Because of the complexity of the kinds of radio isotopes generated, the correction of the decay rate is not easy to calculate. However, if one normal-izes to the single wire, it is automatically taken into account. The measure-ment was taken in four locations; 53 inches, 74.25 inches, 130 inches and 158.25 inches downstream from the edge of the steel yoke of UQ13. Figures 1 and 2 shows the horizontal and vertical profile of the beam at 53 inches downstream of UQ13. Vertical profiles seems to have asymmetry which is not understood. In Figure 3 we plotted the size vs the location of the measurement. The measured size is half width at the 90% of the peak intensity. Plotted along is the calculated half size of the beam from FEB operations manual. The beam emittance assumed for the calculation was:

$$E_x = 2.416 \ \pi \ \text{mm - mrad}$$

$$E_y = 1.864 \ \pi \ \text{mm - mrad}$$

As can be seen in the figure, while the general feature of the plot is similar, the actual size is at least a factor of two smaller than the calculated value. From these results, one can make the following conclusion. The optics of the U-line as calculated is consistent with the measurement. However, the emittance of the beam is at least a factor of four smaller than assumed in both the vertical and horizontal directions. The method of measuring profiles used here seems very adequate for accurate measurement of profiles of the pencil beam. The accurate emittance can be calculated by measuring the profile in free spaces in this method.

We are indebted to Mr. A. Soukas and Mr. J. Balsamo for their help and Dr. J. Cumming for his help and providing the nuclear chemistry counting facility for us.

Distr: Accel. Dept. S&P

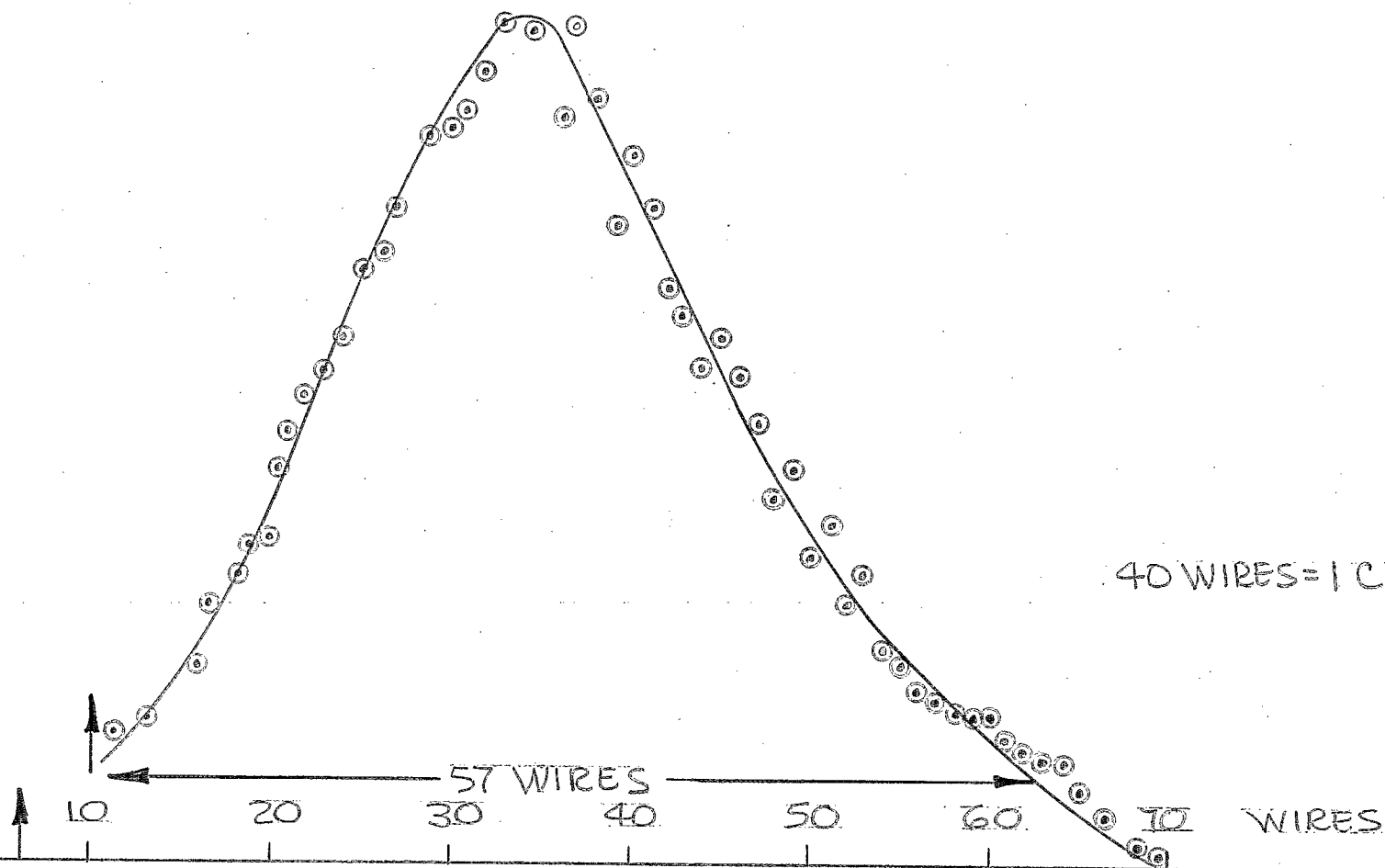FIG. I. FEB HORIZONTAL DISTRIBUTION
AT 53" DOWNSTREAM OF UQI3 YOKE.

40 WIRES = 1 CM.

37 WIRES

FIG.2. FEB VERTICAL DISTRIBUTION
AT 53" DOWNSTREAM OF UQ 13 YOICE

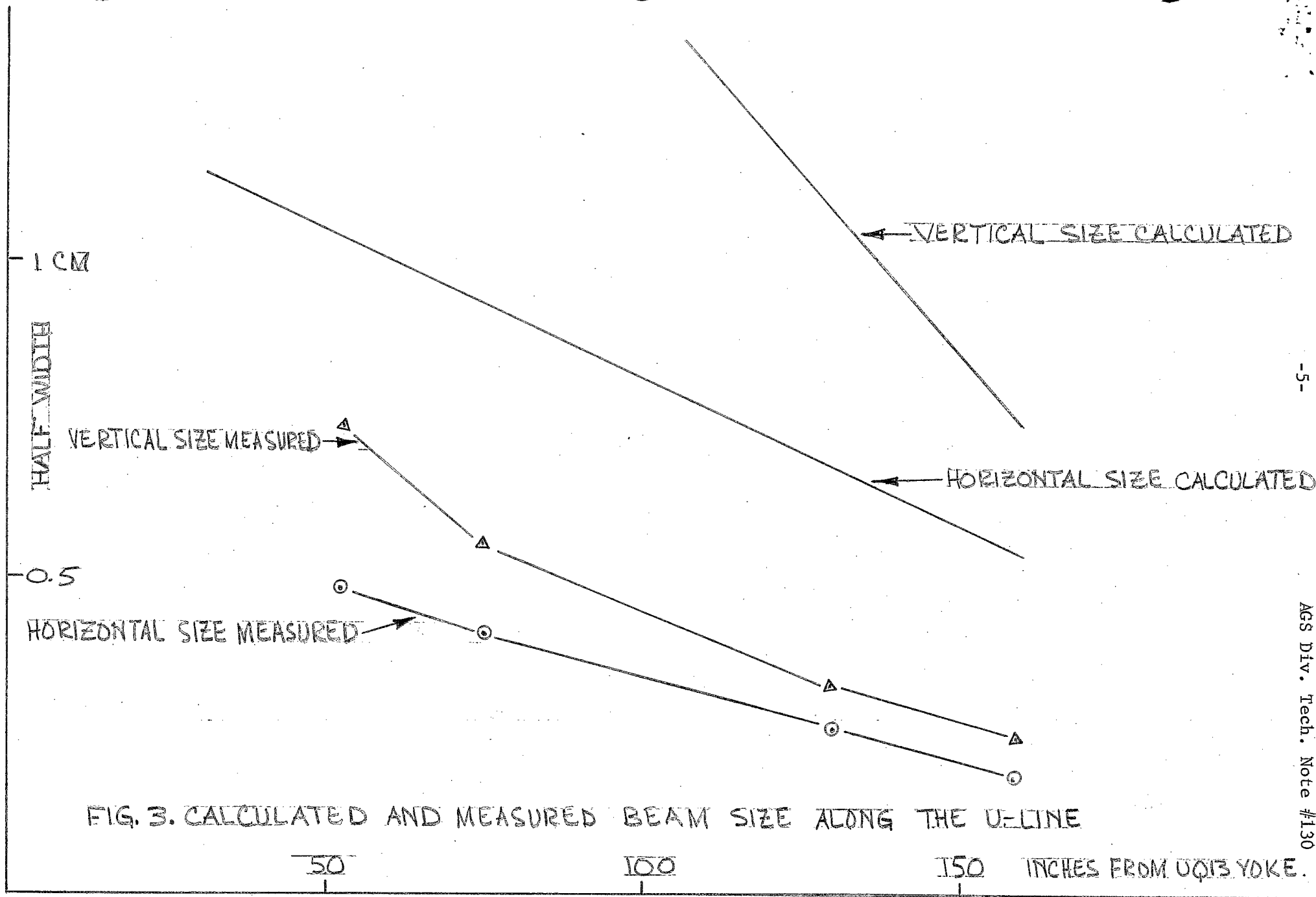40 WIRES=1 CM.

57 WIRES

ARBITRARY UNITS

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FIG. 3. CALCULATED AND MEASURED BEAM SIZE ALONG THE U-LINE

VERTICAL SIZE CALCULATED

HORIZONTAL SIZE CALCULATED

VERTICAL SIZE MEASURED

HORIZONTAL SIZE MEASURED

1 CM

0.5

HALF WIDTH

50   100   150   INCHES FROM UQ13 YOKE.